Development of InAlAs Top Cell for High Specific Power Multijunction Photovoltaics

Completed Technology Project (2015 - 2018)

Project Introduction

The semiconductor material InAlAs has the potential to improve upon current space photovoltaics in a number of ways. InAlAsSb lattice-matched to InP would operate as the top cell in a triple-junction design with an AM0 efficiency of 37.1%, a cell-level mass specific power >1000 W/kg, and panel-level mass specific power of 662 W/kg. Development of InAlAs for engineered substrates would result in a lattice-matched triple-junction cell with a 1-sun AM1.5 efficiency of 40.4%. Additionally, InAlAs lattice-matched to InP has the appropriate bandgap for operation in low-intensity low-temperature conditions. Development of these proposed photovoltaic cells is particularly warranted since the InP materials system is known to be exceptionally radiation tolerant, which is ideal for space operation. Furthermore, lattice-matched cells are lighter and more mechanically stable than their metamorphic counterparts. The technology proposed in this application would increase capability and durability for missions needing onboard power or electric propulsion, and would also correspond to technology gains for terrestrial concentrator photovoltaic systems. The materials proposed in this study have undergone little to no development. Development of these materials would occur via semiconductor growth methods of metal organic vapor phase epitaxy or molecular beam epitaxy. Growth conditions such as temperature, gaseous precursors, and gas ratios can be adjusted to target desired material properties. This research would initially focus on materials development. Once the desired material are grown, they can then be fabricated in complete photovoltaic cells and tested for radiation and temperature tolerance which are important considerations for space applications.

Anticipated Benefits

This technology could increase capability and durability for missions needing onboard power or electric propulsion, and could also correspond to technology gains for terrestrial concentrator photovoltaic systems.

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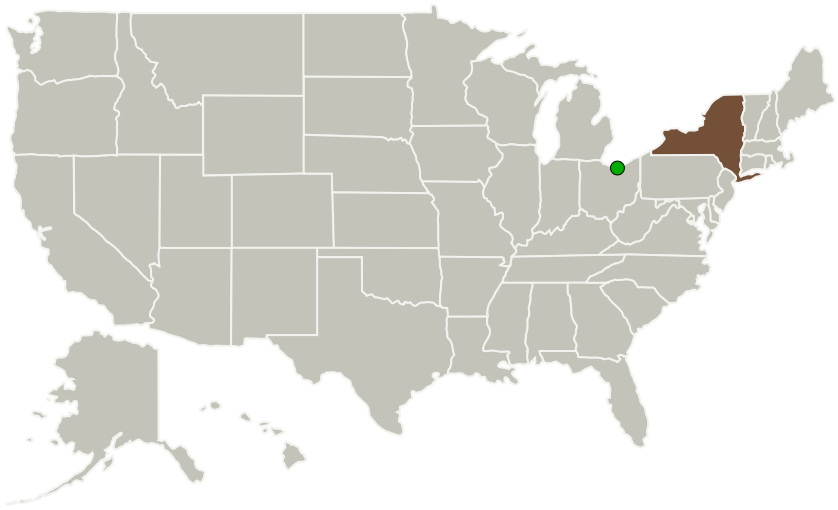
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Rochester Institute of Technology(RIT)	Lead Organization	Academia	Rochester, New York
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
New York

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Rochester Institute of Technology (RIT)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Seth M Hubbard

Co-Investigator:

Brittany N Smith

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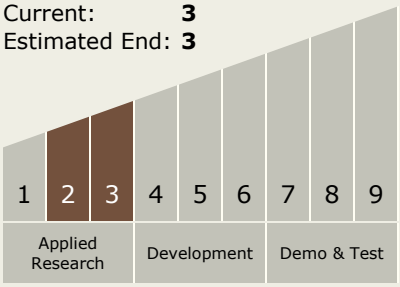
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic

Target Destinations

The Moon, The Sun